

# Selecting Appropriate Requirements Management Tool for Developing Secure Enterprises Software

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**Abstract**— This paper discusses about the significance of selecting right requirements management tools. It's no secret that poorly understood user requirements and uncontrolled scope creep to many software project failures. Many of the application development professionals buy wrong tools for the wrong reasons. To avoid purchasing the more complex and expensive tool, the organization needs to be realistic about the particular problem for which they opt. Software development organizations are improving the methods, they use to gather, analyze, trace, document, prioritize and manage their requirements. This paper considers four leading Requirements Management tools; Analyst Pro, CORE, Cradle and Caliber RM, the focus is to select the appropriate tool according to their capabilities and customers need.

**Index Terms**— Requirements, Software, Organization, Software Development, Requirements Management Tools

## I. Introduction

The majority projects of any size are created from an initial set of customer needs and then these needs are analyzed into the requirements. To meet all the customer's needs and to build right thing right, the numbers of requirements dictate the size and complexity of the project <sup>[1]</sup>. The entire requirement which is analyzed should be managed properly for the success of the project <sup>[2]</sup>. Managing multiple thousands of requirements is a tough task and it takes more than just a spreadsheet, but this is not a new problem for

project managers <sup>[3]</sup>. Over a few decades numbers of Requirements Management Tools have been developed and available in the market for different projects <sup>[4]</sup>. Although some of these tools are currently being used in secure software development. Requirement management tools manage the relationship between functional requirement, business requirement and technical specification. Integration of requirement management tool and tools having activities similar to build management, test management, and configuration management required for the traceability through the lifecycle with significant manual effort <sup>[5]</sup>.

The feature of practitioner's tools like workflow, baseline, security, traceability, collaboration and reporting improves the efficiencies of Application Lifecycle Management <sup>[6]</sup>. The goal of these features is to coordinate various activities which are obliging in software development life cycle <sup>[7]</sup>. A survey is done by an IT analyst firm, InfoTech Research Group, 70% of Information Systems project fail because of flamed requirements and 50% of the project reworks owing to a problem with the requirement. Application development initiative can be doomed by poor requirement practices. It is essentially useless if it fails to meet business needs, however it is well-architected, well-constructed, well-tested and well-documented <sup>[8]</sup>. Defects in the requirements are the main cause of the project failure, which identified during testing. The Common requirement problems are owing to inaccurate or incomplete requirements, requirements changes poorly managed and missed requirements <sup>[8]</sup>. Requirements Management Tools cannot improve the quality of requirement gathering but it makes easier for business analysts and project managers to implement practices

that have the same effects. The Requirements Management Tools serve as the starting point for a chain of traceability. Life cycle traceability cannot be established itself; chain of traceability extension is

shown in Fig.1. The requirement states what the system will or won't do, and who will use the system. Requirement can relate to business process, design, documentation and training users <sup>[9]</sup>.

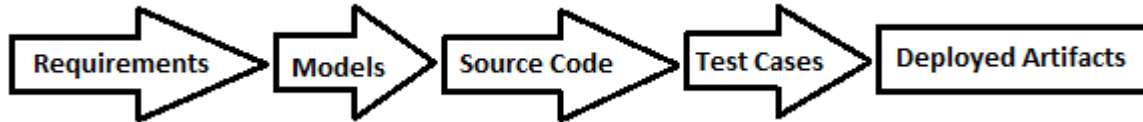


Fig. 1: Chain of Traceability

Select Requirements Management tools that would best fit for the project. Every project of the business and IT organization must include more visual based requirements over text based requirements like model, prototypes and simulation because it enhanced understanding of the system <sup>[10]</sup>. Requirement Management uncovered different concepts of what should actually be included in the process <sup>[1]</sup>. This paper considers four leading Requirements Management tools; Analyst Pro, CORE, Cradle and Caliber RM. First analyze the features and capabilities of the tools, and then select the appropriate tool for software development.

This paper is structured in VI sections. Section I is introduction which discusses the requirement of Requirements Management Tools, its need and benefits. Section II discusses the importance of Requirements Management Tools and Requirement Definition practices. Section III is about selecting right feature Requirements Tool. This section draws attention on not to select more complex and expensive Requirements Management Tools without applications need. Section IV describes the definition and discusses various features of Requirements Management Tools. Section V is the comparative study of the Tools, its strength and weakness is also described. Section VI is a conclusion which gives that none of the Tool is superior or awful but rather analyzes the functionality of the tool and select according to the project requirements.

## II. Significance of Requirements Management

Requirement management plays an important role in software project success as business relies more and more on software for conducting business and some mission-critical functions. Software development projects suffer most when changes in requirements, revision and rework set off delays. Rework is responsible for over 40% of the increment in development costs and time. Most of the rework expenses focus on correcting requirement management information. Owing to mis-communication and insufficiently defined requirement, existing processes for establishing requirements are often extemporized and inefficient <sup>[11]</sup>.

Enterprises can speed up development; reduce rework, save cost and time by ensuring effective requirement Definition at the beginning involving elicitation, analysis, specification and validation <sup>[12]</sup>. All stakeholders must involve in the requirement process to avoid the requirement falling through gaps and avoid adding unrequested functionality. Draft Requirements Documents should include test cases and system requirements so that interpretation of the document differently by different stakeholders to be minimized.

## III. Select Right Featured Requirements Management Tool

Many of the program management team buys the wrong requirements management tool that is out of line with their needs. The requirements management tool is used by analyst, customers, project managers and developers for increasing the efficiency of the requirements management practices. It is obliging in developing mature application software <sup>[13]</sup>. Built requirements tools were previous tools but requirements definition tools are innovative, owing to this buyer assumes that requirement management tools improve their requirements definition practices <sup>[8]</sup>.

The requirements management tool helps the program management professional to reduce work and improve customer satisfaction <sup>[14]</sup>. We should select those tools which will store and provide traceability for requirements, test cases etc. The strengths and weakness of the Requirements Management Tools should be known so that the developer chooses consequently. Application development organization mishandle while selecting the requirements management tools and expecting too much from it. Compiling all the features, exist in the requirements management tool rather than the features that they really need, leads them to acquire more complex and expensive tool <sup>[6]</sup>.

Searching for the right requirements management solution, application development and program management professional often get tripped up by ambition <sup>[15]</sup>. A program management professional thinks if they don't buy the tool which has more features, then they need a full feature tool in near future. They even believed that if in future they need such tool,

they buy it and integrate it with the tool they already have. This leads to purchase a tool which is more complex, expensive and difficult to use [11].

Assume the requirement management within an Application Lifecycle Management solution: the most important benefits of requirement management are an integration of tool with less feature tools, for the activities like change management and test management [7]. Integration of tool with a less feature tool is a daunting task and getting requirements management capabilities as part of the platform [10]. Prefer the tools with right features, not the most features; don't prefer complex, when it is not required [16]. Standalone requirement management tools have the most features, but prefer it when the application needs long and deep requirement hierarchies [10][14]. Focus on requirement definition; the root cause of the problem is requirement definition, not the requirement management. Allocating the budget on tools that is for requirement definition, training business analysts and customer [10].

#### IV. Requirements Management Tools

As described earlier, the process of managing requirement is a daunting task, particularly when the numbers of requirements are thousands and the changes are numerous. There are many Tools which are used to manage requirements like storing requirements in database for developing various documents and other functions as well. There are about 30 distinct requirement tools are available on internet [17]. It is improbable to consider every RM tool out on the market. The final sets of tools included in this paper are Analyst Pro, CORE, Cradle, and Caliber RM.

#### 4.1 Analyst Pro

The Analyst Pro Tool has been developed by a Virginia-based enterprise and system development company in 2000 known as Goda software. Goda Software mainly targets software development companies. Analyst Pro is scalable and it works with any software development process models like Waterfall and Spiral [18]. Analyst client server can handle 250 concurrent users.

Analyst Pro has many capabilities regarding projects, requirement, traceability, use cases, database management, import/export and report generation. By selecting Project modules users can create projects, add/delete users, and assign users specific project. In the Requirements module, the user can specify, track, manage and analyze requirements. The requirement editor allows for creating the hierarchical specification and printing the same in the documented form. Analyst pro has a diagram editor for the creation of UML and Use cases and it can track changes automatically.

The 'Traceability' module allows the user to trace the changes to requirements and it also trace the direct and indirect relationship. One of the key benefits of the Analyst Pro is that all the applications can be accessible from one main menu. Many modules of the requirement are also accessible from the main menu and in a hierarchal format which gives users the graphical representation of the requirement with relationship is shown in Fig. 2.

The 'Output' module allows the user to choose tabular documents, project document, requirements documents and objects documents. This module also allows the users to create and print several requirements documentation with history and graphs. The output of the requirement documentation is in a different format like Microsoft (MS) Word, MS Excel, MS Access Database, Adobe Acrobat, Hypertext Markup Language (HTML) file, or a simple text file.

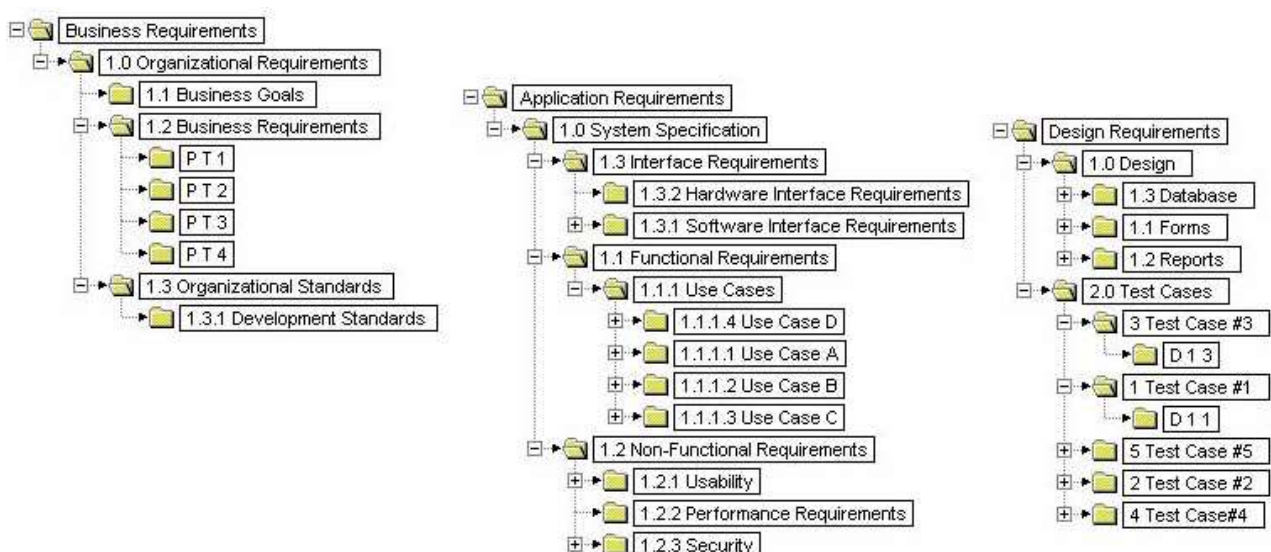


Fig. 2: Analyst Pro Traceability Analysis, Hierarchy of Links for all requirement types (Reprinted courtesy of [19])

**4.2 CORE**

The CORE tool has been developed by Virginia based company known as Vitech Corporation in 1992. CORE covers the functionality of Systems Engineering methodology: the analysis, decomposition, architecture, operational behaviors, allocation and validation of system requirements [20]. CORE has a capability to handle multiple users adding, deleting, changing, and reviewing information from the systems repository. It is centralized; all the users are working from the same baseline and provide consistence result throughout the product development. CORE uses a System Definition Language consisting of elements, relationships, attributes, structures to eliminate the ambiguity of a system.

CORE appeared preloaded with several diagrams including the Physical Block Diagram (PBD), Functional Flow Block Diagram (FFBD), Element Relationship Diagram (ERD), N2 Diagram and

Hierarchy Diagram (HID). CORE also has a dynamic diagram generator which ensures changes made in the diagram are reflected in the repository and vice versa [21].

There are over 100 possible relationships among the different elements. Relationships make easy to locate unfulfilled requirements and unresolved issues. This allows users to open the element table for viewing, updating and adding the elements in the spreadsheet. CORE’s traceability features the view of hierarchical requirement, the type of element, the element name and the relationship between elements is shown in Fig. 3. Information in the repository generates diagram automatically and the diagram can be viewed on full screen, for better visibility and for further modification. Any changes in the repository will automatically reflect in the diagram. Manually extracting elements and loading file from the source document is also possible using element extractor.

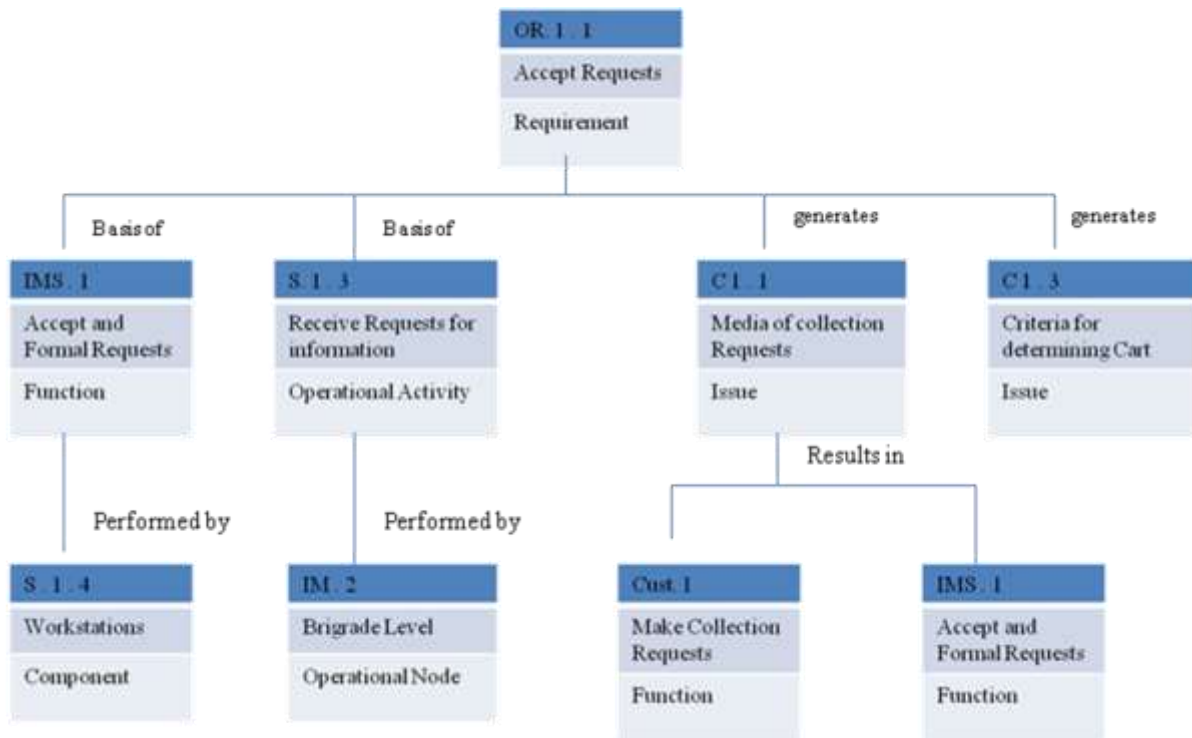


Fig. 3: CORE Hierarchy View. Hierarchical Tree useful for information gathering [20]

**4.3 Cradle**

The Cradle tool has been developed by an England-based company known as Structured Software Systems Limited. Cradle is a systems engineering tool which supports multi-users and multi-projects through the use of a Relational database management system. Cradle consists of 10 modules that can be used in combination with each other or as separate entities. These modules are: Cradle-PDM, Cradle-DOC, Cradle-WEBP, Cradle-WEBA, Cradle-WRK, Cradle-SYS, Cradle-REQ, Cradle-MET, Cradle-PERF, and Cradle-SWE. The key benefits of Cradle workbench and Cradle’s Toolset is

that it allows the user to access all necessary modules for implementing a system engineering process [22].

WEBA and WEBP are Cradle’s Web Access and Web Publisher modules which allow users to extend the capability of a project into the World Wide Web, so that the remote users can have review access to it. Cradle is a perfect for dealing with all phases of Requirement Management, system analysis and design, architecture design, architecture, and business process modeling. It is a complete tool for all phases of the software development life cycle. Cradle activities accomplished while creating a Work Breakdown Structure (WBS),

creating UML and functional models for allocating requirements, capturing requirements in MS Word/Excel and formatting the requirements to generate useful reports [23]. Cradle-PDM, the project data management module, everything about a project is defined in this module as it provides infrastructure to all other modules involved in the project. Each project has its own database and database contains many types of item, and attributes. All other modules with respective to each project will inherit the properties of Cradle-PDM [24].

The Cradle-REQ module maintains; functional, non-functional, user, system and operational requirements. Cradle SYS offers full traceability: requirements can be linked to model tests, risks, architectural entities, analysis and any other project data. Automatically changes to any requirements are placed in history and an alert is sent to the affected users.

Cradle DOC, Cradle Document generation module, allows the users to create and print customizable documents. The main advantages of cradle tool over other tools is that it can load requirement from other tools like Analyst Pro, Core, Caliber RM and return the data in the same format.

#### 4.4 Caliber RM

Caliber RM is developed by Borland software. This tool is used to manage software requirement and modeling the design of the system using UML. This tool is excellent in maintaining traceability between the system requirements and the system model solution. RM tool facilities collaboration, impact analysis and communication and helps the software team to deliver the project within budget [25]. RM also helps small, large and distributed organizations projects that meet the end user needs. Caliber RM allows analyst, developers, testers and other project stakeholders to capture and communicate with the users throughout the application development lifecycle. It enables the developer team to

deliver the project with greater accuracy and predictability.

Caliber RM is feature rich software requirement management tool with a centralized repository system which provides a central and secure repository for the entire project requirement [26]. Other features are adaptability, end to end requirement, end to end impact analysis, traceability, complete lifecycle integration, flexibility and security. Caliber RM makes easier to log on to multiple server with a single login from different locations. It is also a powerful, internet based requirement management system that helps team members to deliver high quality applications. It also enables team to define, manage and communicate changing requirements that is recorded and stored in the central repository system.

Benefits of caliber RM improve collaboration, make accurate prediction, access requirements from anywhere, easy to use GUI, notification of import changes, focus on prioritized requirement etc.

#### V. Comparative Study

The difficulty in comparing the tools from the foremost RM tool is that they are so close in capability. The strengths and weakness of the Requirements Management Tools should be known so that developer chooses consequently. Application development organization mishandle while selecting the requirements management tools and expecting too much from it. Compiling all the features, exist in the requirements management tool rather than the features that they really need, leads them to acquire more complex and expensive tool [6-27]. As a consequence we do not judge the requirements tool as good or bad, but rather analyze the functionality of these tools [4]. Table 1 illustrates a comparison between the four Tools, accordingly select the appropriate tool for the development of secure Enterprises software [10-28].

Table 1: Comparison of tools (according to [10-28])

Tools /Attributes	Baseline	Links and Traceability	Security	Microsoft support	Workflow	Document, Database or Design Centric
Analyst Pro	Yes	Full Traceability	No listed security support	MS word, MS Excel, Access database	Yes	Document Centric
Cradle	Yes	Strong traceability	No listed security support	MS word, MS Excel	Yes	Collaborative Design Centric
CORE	Yes	-	No listed security support	-	-	Collaborative Design Centric
Caliber RM	Yes	Bi-directional Traceability	Centralized Repository provides security	MS word, Excel, Access, Project 2000	Yes	Database Centric

#### VI. Conclusion

Requirements management tools are used by Business analysts, business customers, product

managers, project managers, and developers to increase the efficiency of their requirements management practices.

In this paper we have considered four leading Requirements Management tools; Analyst Pro, CORE, Cradle and Caliber RM for secure software development. After an in depth evaluation and subsequent objective trade-off analysis of each Tools, the caliber RM Tool comes out in front with tying closely between Cradle and Analyst Pro behind. Caliber RM is one of the leading tools that combine the capabilities of requirement definition and requirement management.

Caliber RM is found to be best for the secure software development, and its database is protected. We also advise to include security functions in the database of Analyst Pro and make it the best security requirements tool.

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